

Description

[0001] The present invention relates to a connector and to a connector assembly method.

[0002] A connector is known from Japanese Unexamined Patent Publication No. 2000-150058. This connector is provided with a plurality of auxiliary connectors each having cavities for accommodating terminal fittings, wherein the respective auxiliary connectors are individually accommodated in a plurality of connector accommodating chambers defined in a frame to be assembled into one connector. A sealing member for providing sealing around wires connected with the terminal fittings is mounted on the rear surface of each auxiliary connector and a rear holder for retaining the sealing member is mounted on the rear surface of the sealing member.

[0003] Such a divided-type connector is unavoidably enlarged in an arranging direction (width direction) of the respective auxiliary connectors. Especially, since the frame is formed with partition walls for partitioning the connector accommodating chambers for the respective auxiliary connectors, the width of the frame is increased by a total thickness of the partition walls, and the connector is further enlarged. This may lead to a narrower range of application of the connector.

[0004] The present invention was developed in view of the above problem and an object thereof is to allow the miniaturization of a connector.

[0005] This object is solved according to the invention by the features of the independent claims. Preferred embodiments of the invention are subject of the dependent claims.

[0006] According to the invention, there is provided a connector, comprising:

- a plurality of auxiliary connectors in which one or more terminal fittings can be at least partly accommodated, and
- a frame in which the respective auxiliary connectors can be at least partly accommodated en bloc,

wherein the respective auxiliary connectors are inserted into the frame substantially in an arranging direction through an opening formed in one side surface of the frame, and wherein the auxiliary connectors and/or the frame comprise one or more positioning means for determining the positions of the auxiliary connectors relative to the frame.

[0007] Since the respective auxiliary connectors are inserted into the frame substantially in the arranging direction, partition walls between the auxiliary connectors adjacent in the arranging direction can be deleted from the frame and the connector can be made smaller by as much as a total thickness of the partition walls. Further, since the respective auxiliary connectors are at least partly accommodated in the frame while having the relative positions thereof determined by the positioning means, a positioning function borne by the partitioning walls can

be provided by the positioning means.

[0008] Preferably, a partition wall of one or more mating auxiliary connectors slidably at least partly enters a clearance between facing surfaces of two auxiliary connectors adjacent to each other in the arranging direction when the two auxiliary connectors are connected with the mating auxiliary connectors.

[0009] Since the partition wall of the mating auxiliary connectors slidably at least partly enters the clearance between the facing surfaces of the two auxiliary connectors adjacent to each other in the arranging direction when the two auxiliary connectors are connected with the mating auxiliary connectors, forcible connection of the auxiliary connectors can be prevented. This advantageously makes it unnecessary to provide a special forcible-connection preventing construction, wherefore the connector can be made even smaller.

[0010] Preferably, at least one sealing member for providing sealing around one or more wires connected with terminal fittings is arranged at a rear part of the respective auxiliary connectors.

[0011] Further preferably, a wall portion of the mating auxiliary connector is to be hermetically brought into close contact with a corresponding portion of the sealing member, preferably the outer circumferential surface thereof.

[0012] Still further preferably, a sealing member for providing sealing around wires connected with terminal fittings is arranged at a rear part of the respective auxiliary connectors, and

a surrounding wall of the mating auxiliary connector is hermetically brought into close contact with the outer circumferential surface of the sealing member.

[0013] Since the sealing member possesses a function of providing sealing between the sealing member and the mating auxiliary connectors in addition to a function of providing sealing between the sealing member and the wires connected with the terminal fittings, it is not necessary to provide one auxiliary connector with a plurality of kinds of sealing members, wherefore the number of parts can be reduced.

[0014] Further preferably, at least one rear holder for retaining the sealing member is assembled at a rear part of the respective auxiliary connectors.

[0015] Most preferably, a sealing member for providing sealing around wires connected with terminal fittings is arranged and a rear holder for retaining the sealing member is assembled at a rear part of the respective auxiliary connectors, and

the respective auxiliary connectors are united in the arranging direction by means of the rear holder and accommodated into the frame in a united state, thereby constructing the positioning means.

[0016] Since the respective auxiliary connectors are united or integrally assembled substantially in the arranging direction by the rear holder and are at least partly accommodated into the frame in the united or integrally assembled state to construct the positioning means, as-

sembling operability can be improved at the same time as a sealing performance of the sealing member is ensured.

[0017] According to a further preferred embodiment of the invention, a plurality of rear holders are provided in one-to-one correspondence with the respective auxiliary connectors and can be coupled to each other substantially in the arranging direction.

[0018] Since a plurality of rear holders are provided in one-to-one correspondence with the respective auxiliary connectors and can be coupled to each other substantially in the arranging direction, an operation of inserting the terminal fittings can be performed for each auxiliary connector. As a result, it is unlikely to occur to erroneously insert the terminal fittings and it becomes easier to handle the wires, thereby improving assembling operability.

[0019] Preferably, recess/projection engaging portions are provided on substantially facing surfaces of two rear holders adjacent to each other in the arranging direction, and

the recess/projection engaging portions preferably are engaged or are to be engaged to permit an assembling operation of the two rear holders when the two rear holders are arranged in a correct combination, and preferably cannot be engaged to hinder the assembling operation of the two rear holders when the two rear holders are arranged in a wrong combination.

[0020] Since the recess/projection engaging portions are provided on the facing surface of the two rear holders adjacent to each other in the arranging direction, a situation where the two rear holders are coupled in a wrong combination can be avoided.

[0021] Further preferably, the rear holder is formed with at least one protection wall for at least partly concealing an exposed end surface of the sealing member substantially facing the insertion opening at the auxiliary connector inserted last into the frame.

[0022] Since the exposed end surface of the sealing member facing the insertion opening is at least partly concealed by the protection wall formed on the rear holder at the auxiliary connector at least partly inserted last into the frame, a situation where the sealing member is interfered with by external matters to be, for example, damaged can be avoided.

[0023] Further preferably, at least one protection cap at least partly surrounding the sealing member while defining a clearance thereto is detachably mountable on the respective auxiliary connectors.

[0024] Since the protection cap for at least partly surrounding the sealing member while defining the specified clearance thereto is mounted on the respective auxiliary connector before the auxiliary connectors are positioned by the positioning means, the sealing member can be protected to maintain a specified sealing performance. The protection cap can be detached from the respective auxiliary connectors preferably when the auxiliary connectors are positioned by the positioning means.

[0025] Still further preferably, a retainer for retaining

the substantially properly inserted terminal fittings by being engaged with the terminal fittings is at least partly assembled into at least part of the auxiliary connectors, preferably into each auxiliary connector, and the protection cap preferably is formed with one or more retainer insertion openings for permitting the at least partial insertion of the retainers into the respective auxiliary connectors.

[0026] Since the protection cap preferably is formed with the one or more retainer insertion openings for permitting the insertion of the retainers into the respective auxiliary connectors, the retainers can be at least partly inserted with the protection cap mounted on the respective auxiliary connectors. Therefore, the protection of the sealing member can be doubly assured.

[0027] Most preferably, each auxiliary connector is formed with at least one guidable portion that can be brought into substantially sliding contact with at least one guiding portion of the frame when the auxiliary connector is mounted into the frame, and

the protection cap preferably is formed with at least one mounting portion detachably engageable with the guidable portion before the respective auxiliary connectors are mounted into the frame.

[0028] Preferably each auxiliary connector is formed with the guidable portion that can be brought into sliding contact with the guiding portion of the frame when the respective auxiliary connectors are mounted into the frame, and the protection cap is formed with the mounting portion detachably engageable with the guidable portion before the respective auxiliary connectors are mounted into the frame. Thus, it is not necessary to provide the respective auxiliary connectors with a special construction for mounting the protection cap, wherefore the constructions of the respective auxiliary connectors can be simplified.

[0029] According to the invention, there is further provided a connector, in particular according to the above invention or a preferred embodiment thereof, comprising:

a plurality of auxiliary connectors in which one or more terminal fittings can be at least partly accommodated, and

a frame in which the respective auxiliary connectors can be at least partly accommodated en bloc,

wherein a partition wall of one or more mating auxiliary connectors slidably is to at least partly enter a clearance between facing surfaces of two auxiliary connectors adjacent to each other in the arranging direction when the two auxiliary connectors are connected with the mating auxiliary connectors.

[0030] According to the invention, there is further provided a connector assembly or mounting method for assembling or mounting a connector, in particular according to the above invention or a preferred embodiment thereof, comprising the following steps:

providing a plurality of auxiliary connectors into which one or more terminal fittings are at least partly accommodated, at least partly accommodating the respective auxiliary connectors in a frame en bloc by inserting the respective auxiliary connectors into the frame substantially in an arranging direction through an opening formed in one side surface of the frame, and positioning the auxiliary connectors relative to the frame by means of one or more positioning means provided on the auxiliary connectors and/or the frame.

[0031] According to a preferred embodiment of the invention, the connector assembly method further comprises the following steps:

providing one or more mating auxiliary connectors, and connecting at least two auxiliary connectors with the mating auxiliary connectors thereby slidably at least partly inserting a partition wall of one or more mating auxiliary connectors into a clearance between facing surfaces of two auxiliary connectors adjacent to each other in the arranging direction.

[0032] These and other objects, features and advantages of the present invention will become more apparent upon reading of the following detailed description of preferred embodiments and accompanying drawings. It should be understood that even though embodiments are separately described, single features thereof may be combined to additional embodiments.

FIG. 1 is an exploded perspective view entirely showing a connector according to one embodiment, FIG. 2 is a front view showing the entire connector, FIG. 3 is an exploded perspective view of a auxiliary connector, FIG. 4 is an exploded perspective view of an auxiliary connector inserted last into a frame, FIG. 5 is a perspective view with a horizontal section showing an essential portion immediately before two adjacent rear holders are coupled, FIG. 6 is a perspective view with a horizontal section showing an essential portion when the two adjacent rear holders are coupled, FIG. 7 is a perspective view with a vertical section showing an essential portion when the two adjacent rear holders are coupled, FIG. 8 is an exploded side view in section of the auxiliary connector, FIG. 9 is a perspective view of a protection cap, FIG. 10 is a perspective view showing a state where the protection cap is mounted on the auxiliary connector, FIG. 11 is a side view in section showing a state where the protection cap is mounted on the auxiliary

connector,

FIG. 12 is a perspective view of a mating connector, FIG. 13 is a schematic diagram showing a connected state of the two connectors.

[0033] One preferred embodiment of the present invention is described with reference to FIGS. 1 to 13. A connector according to this embodiment is a (preferably watertight) female connector of the divided type connectable with a mating male connector, wherein one or more, preferably a plurality of (specifically, four) auxiliary connectors 10 can be at least partly accommodated or selectively arrangeable into a frame or frame-like member 60. It should be noted that a side to be connected with the male connector is referred to as front side in the following description.

[0034] As shown in FIGS. 12 and 13, the mating male connector preferably is a connector for circuit board (printed circuit board), and one or more, preferably a plurality of male auxiliary connectors 90 (preferably of a plurality of sizes) are arranged or selectively arrangeable substantially side by side substantially in width direction WD and coupled or fixed to each other by a coupling plate 93 arranged on a side thereof, preferably on the rear surfaces thereof as shown in FIG. 12. Each auxiliary connector 90 includes a receptacle 91 preferably in the form of a substantially rectangular tube having an open front surface. The receptacles 91 adjacent to each other in width direction WD are at least partly partitioned by partition walls 92. One or more male terminal fittings 94 are mounted through the back walls of the receptacles 91, wherein front portions (preferably substantially front halves) of the male terminal fittings 94 project into the receptacles 91 and rear portions (preferably substantially rear halves) thereof are exposed from the rear surface of the coupling plate 93 and preferably bent at an angle different from 0° or 180°, preferably substantially at right angles at one or more their intermediate positions so as to be connectable with conductor paths of the circuit board (not shown). Some of the auxiliary connectors 90 have respective cam pins 95 projecting from the lateral (upper) surfaces of the receptacles 91. These cam pins 95 are or can be at least partly inserted into cam grooves 71 of a lever 70 (as a preferred movable member) mounted on or to the frame 60, and the two connectors are connected with each other as the lever 70 is operated (preferably rotated or pivoted).

[0035] One or more auxiliary connectors 10 (preferably of a plurality of sizes) are prepared so as to substantially correspond to the mating auxiliary connectors 10, and each auxiliary connector 10 includes a auxiliary housing 11, a retainer 35, preferably a sealing member 40 and a rear holder 50 as shown in FIG. 3. The auxiliary housing 11 preferably is substantially in the form of a rectangular parallelepiped made e.g. of a synthetic resin, and one or more, preferably a plurality of cavities 12 into which one or more respective female terminal fittings 30 (corresponding to preferred "terminal fittings") are at least partly

insertable from an inserting side, preferably substantially from behind, are formed in the auxiliary housing 11. The cavities 12 are arranged substantially in width direction WD at each of one or more stages, preferably at each of a plurality of stages defined one after another along height direction HD. One or more step-shaped engaging portions 13 engageable in a hooking manner with one or more locking claws 51 A of respective locking legs 51 provided on the rear holder 50 are formed on the lateral (upper) surface of the auxiliary housing 11. Further, one or more, preferably a pair of protecting walls 14 for protecting the locking legs 51 stand or project at the (preferably substantially opposite) side(s) of the lateral (upper) surface of the auxiliary housing 11. The locking legs 51 preferably are arranged between the protection walls 14, thereby being prevented from being turned up or deflected e.g. by getting caught by an external matter.

[0036] As shown in FIG. 8, an insertion hole 15 for the retainer 35 is formed in the lateral (bottom) surface of each auxiliary housing 11. The insertion hole 15 has such a depth as to communicate with or cross all the cavities 12, and the side-type retainer 35 is at least partly inserted thereinto from a retainer inserting side, preferably substantially from below. The retainer 35 is made e.g. of a synthetic resin material and preferably substantially in the form of a flat plate as a whole, has terminal insertion holes 36 at positions substantially corresponding to the cavities 12, and has one or more, preferably a pair of (front and/or rear) resilient locking pieces 37 projecting from the lateral (upper) wall thereof preferably at the substantially opposite sides. A locking projection 38 is formed at a wall of each terminal insertion hole 36, and the resilient locking pieces 37 are resiliently engageable with one or more retainer locking portions (not shown) formed in the insertion hole 15 for the retainer 35. The retainer 35 is displaceable between a partial locking position (as a preferred first position) and a full locking position (as a preferred second position), and is retained at these positions by the resilient engagement of the resilient locking pieces 37 with the retainer locking portions. When the retainer 35 is at the partial locking position, the locking projections 38 are substantially retracted from the corresponding cavities 12 to permit the insertion of the female terminal fittings 30. On the other hand, when the retainer 35 is pushed or moved from the partial locking position towards or to reach the full locking position, the locking projections 38 at least partly enter the cavities 12 to be located substantially opposite to jaw portions 31 at the rear ends of the female terminal fittings 30 substantially properly inserted into the cavities 12, thereby retaining the female terminal fittings 30.

[0037] As shown in FIG. 3, the one-piece sealing member 40 made e.g. of a resilient material such as of a rubber material preferably is to be mounted on the rear surface of the auxiliary housing 11. This sealing member 40 can be brought into contact with the (preferably substantially entire) rear surface of the auxiliary housing 11 and is formed with one or more wire insertion holes 41 at posi-

tions substantially corresponding to the respective cavities 12, and one or more wires W connected with the female terminal fittings 30 (preferably by crimping, soldering, insulation displacement or the like) can be passed through the respective wire insertion holes 41. Sealing is given between this sealing member 40 and the wires W by bringing one or more, preferably a plurality of (three in the shown example) lips 43 formed at least partly on the inner circumferential surfaces of the wire insertion holes 41 into hermetic or fluid- or watertight contact with the outer circumferential surfaces of the wires W while resiliently compressing them as shown in FIG. 11. The sealing member 40 is also formed with one or more locking-leg insertion holes 42 at one or more (upper and/or lower) positions preferably with the respective wire insertion holes 41 located between these upper and lower positions, and the locking legs 51 can be inserted through the locking-leg insertion holes 42. One or more, preferably a plurality of (three in the shown example) lips 43 are also formed on the outer circumferential surface of the sealing member 40. The sealing member 40 comes into hermetic or fluid- or watertight contact with the surrounding wall of the receptacle 91 while resiliently compressing the lips 43 when the mating auxiliary connector 90 is fitted on or to the sealing member 40, thereby providing sealing between the mating auxiliary connector 90 and the sealing member 40.

[0038] The rear holder 50 for retaining or positioning the sealing member 40 includes a holder main body 52 made e.g. of a synthetic resin and preferably having the shape of a substantially rectangular block. The holder main body 52 is formed with one or more, preferably a plurality of insertion paths 53 at positions substantially corresponding to the wire insertion holes 41 of the sealing member 40, wherein the insertion paths 53 are used to at least partly insert the female terminal fittings 30 and the wires W connected therewith into the wire insertion holes 41. The insertion paths 53 preferably have a diameter equal to or slightly larger than box portions 32 of the female terminal fittings 30, so that the wires W connected with the female terminal fittings 30 can be loosely insertable therethrough. One or more (preferably substantially plate-shaped) locking legs 51 project forward at one or more (upper and/or lower) positions of the holder main body 52 preferably with the respective insertion paths 53 located between these upper and lower positions. The locking legs 51 preferably have such a length as to extend over the upper and bottom surfaces of the auxiliary housing 11 after passing through the locking-leg insertion holes 42 of the sealing member 40 from behind, and the locking claws 51A formed at the leading ends of the locking legs 51 are or can be resiliently engaged with the engaging portions 13 of the auxiliary housing 11, whereby the rear holder 50 is fixedly mounted on or to the auxiliary housing 11 with the sealing member 40 squeezed or arranged or sandwiched between the auxiliary housing 11 and the rear holder 50. In this embodiment, there are prepared rear holders 50 having up to three pairs of upper

and lower locking legs 51 substantially in conformity with the sizes of the respective auxiliary housings 11.

[0039] The respective rear holders 50 are coupled in an arranging direction AD (preferably substantially parallel to the width direction WD) preferably while the lateral edges thereof at least partly abut on each other. Thus, the respective auxiliary housings 11 are held united or integrally held substantially side by side by means of the rear holders 50. More specifically, as shown in FIGS. 5 and 6, a recess 54 and a projection 55 are provided in and/or on facing surfaces of two rear holders 50 adjacent to each other in the arranging direction AD, and the projection 55 is (preferably resiliently) at least partly fitted into the recess 54 preferably by sliding the lateral edges of the two adjacent rear holders 50 along forward and backward directions FBD (being arranged at an angle different from 0° or 180°, preferably substantially normal to the arranging direction AD), thereby preventing the rear holders 50 from being separated in forward and backward directions FBD. A positioning piece 56 projects from one of the two rear holders 50 toward the other, and displacements of the two rear holders 50 on at least one of the directions along forward and backward directions FBD are prevented by the contact of this positioning piece 56 with a stepped portion of the other rear holder when the coupling operation is completed.

[0040] As shown in FIG. 7, one or more guide ribs 57 and one or more guide-rib receiving grooves 58 (corresponding to preferred "recess/projection engaging portions") engageable with each other are formed at one or more height positions preferably different from the aforementioned recess 54 and projection 55 on the facing surfaces of the two rear holders 50 preferably substantially adjacent to each other in the arranging direction AD. The guide ribs 57 preferably have a dovetail or undercut cross section and extend substantially in forward and backward directions FBD, and an assembling operation of the rear holders 50 is substantially guided by relative sliding movements of the guide ribs 57 and the guide-rib receiving grooves 58. The preferably dovetail engagement of the guide ribs 57 and the guide-rib receiving grooves 58 prevents the rear holders 50 from being separated along width direction WD (or arranging direction AD). By preferably differing the engaging height positions of the guide ribs 57 and the guide-rib receiving grooves 58 among the respective rear holders 50, the two rear holders 50 conform and can be engaged in the case of a correct combination and do not conform and cannot be engaged in the case of a wrong combination. Such a construction for preventing an erroneous mounting of the two rear holders 50 is preferable.

[0041] One or more, preferably a pair of guidable portions 59 preferably substantially in the form of rail grooves are so formed in one or more lateral surfaces, preferably in both upper and lower surfaces of the two rear holders 50 as to extend substantially in arranging direction AD (or in width direction WD) and make preferably openings in the opposite lateral surfaces of the rear holders 50.

One or more guiding portions 65 formed in the frame 60 slide at least partly in or substantially along the guidable portions 59 to guide and insert the rear holders 50 or the auxiliary connectors 10 into the frame 60 or substantially properly mount the auxiliary connectors 10 to the frame 60.

[0042] As shown in FIG. 4, preferably only one lock portion 50B engageable with the frame 60 is formed on the lateral (upper) surface of the rear holder 50 of the auxiliary connector 10 at least partly inserted last into the frame 60 (hereinafter, "last auxiliary connector 10A"). The lock portion 50B projects on the lateral (upper) surface of a covering wall 59A for at least partly covering the guidable portion 59, and is resiliently engageable with an interlocking portion 61 formed in the frame 60 by a resilient deformation of the covering wall 59A into the guidable portion 59. Further, the last auxiliary connector 10A is formed with a protection wall 50H projecting substantially forward from one lateral edge of the rear holder 50. This protection wall 50H is arranged to extend substantially along one lateral end surface of the sealing member 40. More specifically, the protection wall 50H preferably is formed into one closing plate standing over the entire length along height direction HD, and at least partly conceals an exposed end surface of the sealing member 40 located in an insertion opening 60A of the frame 60 when the last auxiliary housing 11 is mounted into the frame 60.

[0043] The frame 60 is similarly made e.g. of a synthetic resin and preferably substantially in the form of a flat framework, and has an open front surface and one open side surface as shown in FIGS. 1 and 2. The respective auxiliary connectors 10 can be successively mounted substantially along the arranging direction AD to or into the frame 60 through the open lateral (side) surface of the frame 60 as an insertion opening 60A. One or more, preferably a pair of supporting shafts 62 for rotatably or pivotably supporting the lever 70 (as a preferred movable member) project from the lateral (upper and/or lower) walls of the frame 60 (or from one or more lateral walls where the auxiliary housings 10 are not to be inserted through). The lever 70 preferably is gate-shaped as a whole by having an operable portion 72 and a pair of arm portions 73, and is so mounted as to straddle or bridge or span the frame 60 with both arm portions 73 supported on the supporting shafts 62. The lever 70 is rotated or pivoted in an operating direction (e.g. counter-clockwise) from a rotation starting position RSP shown in FIG. 1 to reach a rotation ending position, thereby coming into engagement with a side wall of the frame 60. The arm portions 73 of the lever 70 are formed with the one or more cam grooves 71 engageable with the cam pins 95 of the mating auxiliary connectors 10.

[0044] When the mating auxiliary connectors 90 are connected with the corresponding auxiliary connector 10 after the auxiliary connectors 10 are mounted to or into the frame 60 with the lever 70 located at the rotation starting position RSP, the cam pins 95 at least partly enter the entrances of the cam grooves 71 of the lever 70. If

the lever 70 is operated (rotated or pivoted) towards or to the rotation ending position in this state, the cam pins 95 move along the cam grooves 71 to exhibit a cam action therebetween, with the result that the two connectors are pulled toward each other or their connection is assisted. One or more, preferably a pair of opening preventing walls 63 are so provided on the lateral (upper and/or lower) walls of the frame 60 as to at least partly cover the outer sides of the arm portions 73, thereby preventing the arm portions 73 from being deformed away from each other upon connecting the two connectors.

[0045] The frame 60 has one connector accommodating space 64 capable of at least partly accommodating the respective auxiliary connectors 10 preferably en bloc without being partitioned by partition walls, and one or more, preferably a pair of rail-shaped guiding portions 65 are provided on the inner surface(s) of the lateral (upper and/or lower) wall(s) as to substantially extend in arranging direction AD (or substantially in width direction WD). One or more, preferably a pair of receiving walls 66 extending substantially in parallel with the guiding portions 65 behind the guiding portions 65 are formed on the inner surface(s) of the lateral (upper and/or lower) wall(s) of the frame 60. Further, (preferably substantially rectangular) interlocking portions 61 are so formed near the insertion opening 60A as to penetrate the respective (upper and/or lower) wall(s) of the frame 60. In the frame 60, an area before the receiving walls 66 serves as the connector accommodating space 64 and an area therebehind serves as a wire accommodating space 67 for at least partly accommodating the wires W drawn out through the rear surfaces of the rear holders 50 preferably substantially en bloc. The frame 60 preferably is also formed with a rear wall 68 for bending and guiding the wires W drawn out from the respective auxiliary connectors 10 at an angle different from 0° or 180°, preferably substantially normal, preferably substantially toward the same side as the insertion opening 60A.

[0046] The respective auxiliary connectors 10 are slid into the frame 60 substantially in their arranging direction AD through the insertion opening 60A while preferably being united with each other by means of the rear holders 50. At this time, the one or more guidable portions 59 and the one or more guiding portions 65 are engaged substantially in forward and backward directions FBD, whereby the respective auxiliary connectors 10 are positioned with respect to forward and backward directions FBD in the frame 60. When the last auxiliary connector 10A is mounted, the lock portion 50B of the rear holder 50 thereof is resiliently at least partly fitted into the interlocking portion 61 of the frame 60, with the result that the respective auxiliary connectors 10 are positioned with respect to width direction WD (arranging direction AD) and are prevented from coming out of the insertion opening 60A. In this case, the lateral edge of the auxiliary connector 10 preferably inserted first comes substantially into contact with the back wall 69 of the frame 60, thereby preventing any further insertion of the auxiliary connec-

tors 10. Upon connecting the auxiliary connectors 10 with the mating auxiliary connectors 90, pressing forces act in connecting direction CD (or forward and backward directions FBD) of the mating auxiliary connectors 90. However, these pressing forces are substantially received by the receiving walls 66 to hinder backward displacements of the respective auxiliary connectors 10.

[0047] The sealing members 40 preferably are protected by one or more protection caps 20 at least until the respective auxiliary connectors 10 are united by means of the rear holders 50. Each protection cap 20 is made e.g. of a synthetic resin, has such a tubular shape as to at least partly surround the side surfaces of the corresponding auxiliary housing 11 and has open front and rear surfaces as shown in FIGS. 9 and 10. This protection cap 20 is to be mounted on the auxiliary connector 10 substantially from front, and one or more temporarily holding claws 21 formed at the rear end thereof are resiliently engaged with the guidable portions 59 in a hooking manner, whereby the protection cap 20 is or can be temporarily held onto or positioned with respect to the auxiliary connector 10. The temporarily held protection cap 20 is to be arranged to at least partly surround the corresponding auxiliary housing 11 and sealing member 40 while defining clearances thereto. A hanging wall 22 that can be substantially opposed to the locking-leg projection walls 14 standing on the auxiliary housing 11 is formed at the front upper part of the protection cap 20. A retainer insertion opening 23 used to pass the retainer 35 into the insertion hole 15 is formed in the lateral (bottom) surface of each protection cap 20 at a position substantially corresponding to the insertion hole 15 for the retainer 35.

[0048] Such a protection cap 20 preferably is to be mounted onto the corresponding auxiliary connector 10 from front before the female terminal fittings 30 are mounted into the auxiliary housing 11. The protection cap 20 is pulled forward after the female terminal fittings 30 are mounted and the retainer 35 is mounted, preferably thereby forcibly disengaging the temporarily holding claws 21 from the guidable portions 59 to detach the protection cap 20 from the auxiliary connector 10. Upon pulling the protection cap 20, one or more flange portions 24 formed to bulge out sideways from the opposite lateral edges of the opening of the protection cap 20 are or can be gripped or manipulated.

[0049] Next, a procedure of assembling this embodiment is described. First, the sealing member 40 is attached or mounted to the rear surface of each auxiliary housing 11, and the rear holder 50 is mounted in this state by passing the one or more locking legs 51 of the rear holder 50 through the respective locking-leg insertion holes 42 of the sealing member 40. The one or more locking claws 51 A of the respective locking legs 51 are resiliently engaged with the corresponding engaging portions 13 of the auxiliary housing 11, whereby the rear holder 50 is mounted on or to the auxiliary housing 11 with the sealing member 40 substantially therebetween.

[0050] Subsequently, the protection cap 20 preferably is mounted or slid substantially from front to resiliently and temporarily fit the one or more temporarily holding claws 21 of the protection cap 20 into the guidable portion 59, thereby substantially protecting the sealing member 40. The respective auxiliary connectors 10 are shipped with the sealing members 40 protected by the protection caps 20 to a harness assembling site. At the assembling site, the retainer 35 is first at least partly inserted into the auxiliary housing 11 from the retainer inserting side, preferably substantially from below, through the retainer insertion opening 23 of the protection cap 20 to hold or position the retainer 35 at the partial locking position (first position). In this state, the one or more female terminal fittings 30 connected with the wires W are at least partly inserted from the inserting side, preferably substantially from behind, into the one or more respective cavities 12 of the auxiliary housing 11 after being successively passed through the respective insertion paths 53 of the rear holder 50 and the respective wire insertion holes 41 of the sealing member 40, and are partly locked by locking portions 18 resiliently deformably formed at the inner surfaces of the cavities 12. Thereafter, as shown in FIG. 11, the retainer 35 is inserted deeper towards or to substantially reach the full locking position (second position), thereby fully (or preferably doubly) locking the female terminal fittings 30 by the locking projections 38 of the retainer 35 to securely retain the female terminal fittings 30. Subsequently, the temporarily held state by the guidable portions 59 and the temporarily holding claws 21 is canceled preferably by pulling the protection cap 20 forward by gripping or manipulating the flange portions 24, whereby the protection cap 20 is or can be detached from the auxiliary connector 10.

[0051] After the mounting operation of the female terminal fittings 30 is completed for all the auxiliary connectors 10, two adjacent rear holders 50 preferably are slid into engagement substantially in forward and backward directions FBD while the one or more guide ribs 57 and the one or more guide-rib receiving grooves 58 are engaged with each other, and further coupled in such a manner as to prevent the separation thereof preferably by the resilient engagement of the recess 54 and the projection 55. After one pair of auxiliary connectors 10 are united in this way, the rear holder 50 of another auxiliary housing 10 is coupled to one of the two rear holders 50. In this way, the respective auxiliary connectors 10 are successively united or integrally coupled substantially in the arranging direction AD. In this embodiment, four auxiliary connectors 10 are united (assembled), wherein the last auxiliary connector 10A is located at the right end. In such a united state, the guidable portions 59 of the respective auxiliary connectors 10 are substantially continuous on a substantially straight line along width direction WD (arranging direction AD) preferably substantially without any discontinuity. Any smaller discontinuity may be accommodated or substantially corrected by the interaction of the one or more guidable portions

59 of the auxiliary connector 10 and the one or more respective guiding portions 65 of the frame 60.

[0052] Subsequently, the respective auxiliary connectors 10 united in this manner are at least partly inserted into the connector accommodating space 64 of the frame 60 through the insertion opening 60A. The guidable portions 59 of the auxiliary connector 10 at the one (left) end are at least partly fitted to the guiding portions 65 of the frame 60 at the start of the inserting operation, and the respective auxiliary connectors 10 are pushed toward the back side of the connector accommodating space 64 in this state. Then, the respective auxiliary connectors 10 are at least partly inserted into the frame 60 while being guided by the guiding portions 65, and the lock portion 50B provided on the last auxiliary housing 10A is resiliently engaged with the interlocking portion 61 of the frame 60 as the respective auxiliary connectors 10 reach substantially proper mount positions. When the respective auxiliary connectors 10 are substantially properly mounted, the sealing member 40 of the last auxiliary connector 10A is located at a position substantially facing the insertion opening 60A of the frame 60, wherein the exposed end surface thereof is at least partly concealed by the protection wall 50H of the rear holder 50H to protect the sealing member 40 e.g. from external matters (see FIG. 2). The respective auxiliary connectors 10 are held positioned relative to the frame 60 with intervals therebetween preferably held substantially constant by the rear holders 50. Further, the wires W drawn out from the respective auxiliary connectors 10 preferably are at least partly bundled, at least partly accommodated in the wire accommodating space 67, and pulled out in a specified (predetermined or predeterminable) direction.

[0053] When the assembling is completed in this way, the mating auxiliary connectors 90 are loosely fitted to the auxiliary connectors 10 and the lever 70 is operated (preferably rotated or pivoted) in this state, thereby preferably connecting auxiliary connectors 10, 90 to a proper depth or assisting their connection. During the connecting operation, the partition walls 92 of the mating auxiliary connectors 90 slidably at least partly enter clearances between the facing surfaces of the adjacent rear holders 50 and the auxiliary connectors 10, 90 are smoothly connected by being guided by the facing surfaces as shown in FIG. 13. When the auxiliary connectors 10, 90 are substantially properly connected, the sealing members 40 are resiliently compressed substantially in forward and backward directions FBD by connection compressing forces acting between the mating auxiliary connectors 90 and the receiving walls 66, whereby the wire insertion holes 41 are deformed to narrow their diameters to come into close contact with the outer circumferential surfaces of the wires W. As a result, secure sealing can be provided between the sealing members 40 and the wires W. Further, when the auxiliary connectors 10, 90 are properly connected, the surrounding walls of the receptacles 91 are closely fitted onto the sealing members 40, whereby the lips 43 of the sealing members 40 are squeezed

by at least part of the surrounding walls of the receptacles 91. As a result, secure sealing can be provided between the sealing members 40 and the mating auxiliary connectors 90.

[0054] As described above, since the partition walls of the frame between the auxiliary connectors 10 adjacent in the arranging direction AD are or can be dispensed with according to this embodiment, the connector can be made smaller by as much as a total thickness of the partition walls. By inserting the respective auxiliary connectors 10 united by the rear holders 50 into the frame 60 in the arranging direction AD, the relative positions of the auxiliary connectors 10 with respect to the frame 60 are determined. Thus, the respective auxiliary connectors 10 can be substantially positioned in the frame 60 even without the partition walls. If coupling structures are provided between the auxiliary connectors 10 in this case, sealing performances of the sealing members 40 cannot be obtained. However, according to this embodiment, specified sealing performances can be given by the sealing members 40 since the respective auxiliary connectors 10 are united utilizing the rear holders 50.

[0055] Further, since the respective auxiliary connectors 10 united or coupled or integrally assembled by the one or more rear holders 50 are at least partly inserted into the frame 60, assembling operability is better. Furthermore, since a plurality of rear holders 50 preferably are provided in one-to-one correspondence with the respective auxiliary connectors 10 and can be coupled to each other in the arranging direction, the operation of inserting the female terminal fittings 30 can be performed for each auxiliary connector 10. As a result, it is unlikely to occur to erroneously insert the female terminal fittings 30 and it becomes easier to handle the wires W, thereby making assembling operability even better.

[0056] Before the start of the connection with the mating connectors, the one or more sealing members 40 preferably are constantly protected by the protection caps 20 and the protection wall 50H. Thus, specified sealing performance can be securely exhibited. Since the protection cap 20 is mounted utilizing the guideable portions 59 in this case, it is not necessary to provide a special construction for mounting the protection cap 20 on the auxiliary connector 10.

[0057] Further, since the partition walls 92 of the mating auxiliary connectors 90 slidably at least partly enter the clearances between the facing surfaces of the auxiliary connectors 10 adjacent to each other in the arranging direction AD when the mating auxiliary connectors 90 are connected with the auxiliary connectors 10, the forcible connection of the auxiliary connectors 10, 90 can be prevented by substantially guiding the connecting operation by the facing surfaces. This makes it unnecessary to provide a special forcible-connection preventing construction, enabling the further miniaturization of the connector.

[0058] Furthermore, the sealing members 40 preferably come to possess a function of providing sealing be-

tween the mating auxiliary connectors 90 and the sealing members 40 in addition to a function of providing sealing between the wires W connected with the female terminal fittings 30 and the sealing members 40 after the connection with the mating connectors. Thus, it is not necessary to provide one auxiliary connector 10 with a plurality of kinds of sealing members 40, thereby reducing the number of parts.

[0059] Accordingly, to miniaturize a connector one or more auxiliary connectors 10 (preferably of a plurality of sizes) are prepared. Each auxiliary connector 10 includes an auxiliary housing 11, preferably a sealing member 40 attached to the rear surface of the auxiliary housing 11, and at least one rear holder 50 mounted on the rear surface of the sealing member 40 to preferably retain the sealing member 40. Two auxiliary connectors 10 adjacent to each other in an arranging direction AD are united with each other preferably by means of the rear holders 50. The respective united auxiliary connectors 10 are at least partly inserted into a frame 60 in the arranging direction AD through an insertion opening 60A of the frame 60, and are retained in the frame 60 by the resilient engagement of a lock portion 50B provided preferably on the last auxiliary connector 10A and an interlocking portion 61 of the frame 60. Since partition walls between the respective auxiliary connectors 10 are preferably deleted or omitted from the frame 60, the connector can be narrowed by as much as a total thickness of the partition walls.

[0060] The present invention is not limited to the above described and illustrated embodiment. For example, the following embodiments are also embraced by the technical scope of the present invention as defined by the claims. Beside the following embodiments, various changes can be made without departing from the scope and spirit of the present invention as defined by the claims.

(1) Although the respective auxiliary connectors are at least partly inserted into the frame after being united by the rear holders in the foregoing embodiment, they may be at least partly inserted into or mounted to the frame individually or in smaller groups through the insertion opening and may be united in the frame. In short, it is sufficient to be able to at least partly accommodate the respective auxiliary connectors while determining the positions thereof relative to the frame even if there are no partition walls.

(2) Although the rear holder is provided for each auxiliary connector in the foregoing embodiment, one rear holder may be provided for all or some of auxiliary connectors according to the present invention.

(3) Although the lock portion engageable with the frame is provided only on the last auxiliary connector in the foregoing embodiment, it may be provided on each auxiliary connector according to the present invention.

(4) Although the protection caps are kept mounted

on the auxiliary connectors also during the operation of mounting the female terminal fittings in the foregoing embodiment, they may be detached from the auxiliary connectors before starting the operation of mounting the female terminal fittings according to the present invention.

(5) The present invention is also applicable to a male connector in which a plurality of auxiliary connectors having the male terminal fittings mounted therein are accommodated in a frame.

(6) The present invention is also applicable to non-watertight connectors. In such a case, means for positioning auxiliary connectors relative to a frame may be provided on the auxiliary housings.

(7) The present invention is also applicable to connectors being connectable to each other without the assistance of a lever displaying a cam action.

(8) Even though in the above embodiment the auxiliary connectors are inserted into the frame through one single opening provided in the side surface, it should be understood that the auxiliary connectors may be at least partly inserted into one, two or more (preferably separate) openings provided in the side surface and/or back surface and/or front surface of the frame.

(9) Even though in the above embodiment a rotatable or pivotable lever displaying a cam action is described as the preferred operable member, it should be understood that other operable members displaying a cam action such as sliders having a different operation path such as a substantially linear operation path may be used to connect the connectors or to assist their connection.

LIST OF REFERENCE NUMERALS

[0061]

10 ...	auxiliary connector
10A ...	last auxiliary connector
11 ...	auxiliary housing
20 ...	protection cap
21 ...	temporarily holding claws (mounting portion)
23 ...	retainer insertion opening
30 ...	female terminal fitting (terminal fitting)
35 ...	retainer
40 ...	sealing member
50 ...	rear holder
50B ...	lock portion
50H ...	protection wall
57 ...	guide rib (recess/projection engaging portions)
58 ...	guide-rib receiving groove (recess/projection engaging portions)
59 ...	guidable portion
60 ...	frame
60A ...	opening
61 ...	interlocking portion

64 ...	connector accommodating space
65 ...	guiding portion
66 ...	receiving wall
69 ...	back wall of the frame
5 70 ...	lever (operable member)
71 ...	cam groove
73 ...	arm portion

90 ...	mating auxiliary connector (mating connector)
10 91 ...	receptacle
92 ...	partition wall
W ...	wire

15 Claims

1. A connector, comprising:

a plurality of auxiliary connectors (10) in which one or more terminal fittings (30) can be at least partly accommodated, and
a frame (60) in which the respective auxiliary connectors (10) can be at least partly accommodated en bloc,

wherein the respective auxiliary connectors (10) are inserted into the frame (60) substantially in an arranging direction (AD) through an opening (60A) formed in one side surface of the frame (60), and wherein the auxiliary connectors (10) and/or the frame (60) comprise one or more positioning means (50; 59, 65) for determining the positions of the auxiliary connectors (10) relative to the frame (60).

2. A connector according to claim 1, wherein a partition wall (92) of one or more mating auxiliary connectors (90) slidably is to at least partly enter a clearance between facing surfaces of two auxiliary connectors (10) adjacent to each other in the arranging direction (AD) when the two auxiliary connectors (10) are connected with the mating auxiliary connectors (90).

3. A connector according to one or more of the preceding claims, wherein at least one sealing member (40) for providing sealing around one or more wires (W) connected with terminal fittings (30) is arranged at a rear part of the respective auxiliary connectors (10).

4. A connector according to claim 3 in combination with claim 2, wherein a wall portion (91) of the mating auxiliary connector (90) is to be hermetically brought into close contact with a corresponding portion of the sealing member (40), preferably the outer circumferential surface thereof.

5. A connector according to claim 3 or 4, wherein at least one rear holder (50) for retaining the sealing member (40) is assembled at a rear part of the respective

auxiliary connectors (10).

6. A connector according to one or more of the preceding claims, wherein the respective auxiliary connectors (10) are united substantially in the arranging direction (AD) by means of at least one rear holder (50) and at least partly accommodated into the frame (60) in a united state, thereby constructing the positioning means (50).

7. A connector according to claim 5 or 6, wherein a plurality of rear holders (50) are provided in one-to-one correspondence with the respective auxiliary connectors (10) and can be coupled to each other substantially in the arranging direction (AD).

8. A connector according to claim 7, wherein:

recess/projection engaging portions (57, 58) are provided on substantially facing surfaces of two rear holders (10) adjacent to each other in the arranging direction (AD), and the recess/projection engaging portions (57, 58) preferably are to be engaged to permit an assembling operation of the two rear holders (50) when the two rear holders (50) are arranged in a correct combination, and preferably cannot be engaged to hinder the assembling operation of the two rear holders (50) when the two rear holders (50) are arranged in a wrong combination.

9. A connector according to any one of claims 5 to 8, wherein the rear holder (50) is formed with at least one protection wall (50H) for at least partly concealing an exposed end surface of the sealing member (40) substantially facing the insertion opening (60A) at the auxiliary connector (10A) inserted last into the frame (60).

10. A connector according to any one of claims 3 to 9, wherein at least one protection cap (20) at least partly surrounding the sealing member (40) while defining a clearance thereto is detachably mountable on the respective auxiliary connectors (10).

11. A connector according to one or more of the preceding claims, wherein:

a retainer (35) for retaining the substantially properly inserted terminal fittings (30) by being engaged with the terminal fittings (30) is assembled into at least part of the auxiliary connectors (10), and the protection cap (20) preferably is formed with one or more retainer insertion openings (23) for permitting the at least partial insertion of the retainers (35) into the respective auxiliary connectors (10).

12. A connector according to one or more of the preceding claims, wherein:

each auxiliary connector (10) is formed with at least one guidable portion (59) that can be brought into sliding contact with at least one guiding portion (65) of the frame (60) when the auxiliary connector (10) is mounted into the frame (60), and the protection cap preferably is formed with at least one mounting portion (21) detachably engageable with the guidable portion (59) before the respective auxiliary connectors (10) are mounted into the frame (60).

13. A connector, in particular according to one or more of the preceding claims, comprising:

a plurality of auxiliary connectors (10) in which one or more terminal fittings (30) can be at least partly accommodated, and a frame (60) in which the respective auxiliary connectors (10) can be at least partly accommodated en bloc,

wherein a partition wall (92) of one or more mating auxiliary connectors (90) slidably is to at least partly enter a clearance between facing surfaces of two auxiliary connectors (10) adjacent to each other in the arranging direction (AD) when the two auxiliary connectors (10) are connected with the mating auxiliary connectors (90).

14. A connector assembly method for assembling a connector, comprising the following steps:

providing a plurality of auxiliary connectors (10) into which one or more terminal fittings (30) are at least partly accommodated, at least partly accommodating the respective auxiliary connectors (10) in a frame (60) en bloc by inserting the respective auxiliary connectors (10) into the frame (60) substantially in an arranging direction (AD) through an opening (60A) formed in one side surface of the frame (60), and positioning the auxiliary connectors (10) relative to the frame (60) by means of one or more positioning means (50; 59, 65) provided on the auxiliary connectors (10) and/or the frame (60).

15. A connector assembly method according to claim 14, further comprising the following steps:

providing one or more mating auxiliary connectors (90), and connecting at least two auxiliary connectors (10) with the mating auxiliary connectors (90) thereby slidably at least partly inserting a partition wall

(92) of one or more mating auxiliary connectors (90) into a clearance between facing surfaces of two auxiliary connectors (10) adjacent to each other in the arranging direction (AD).

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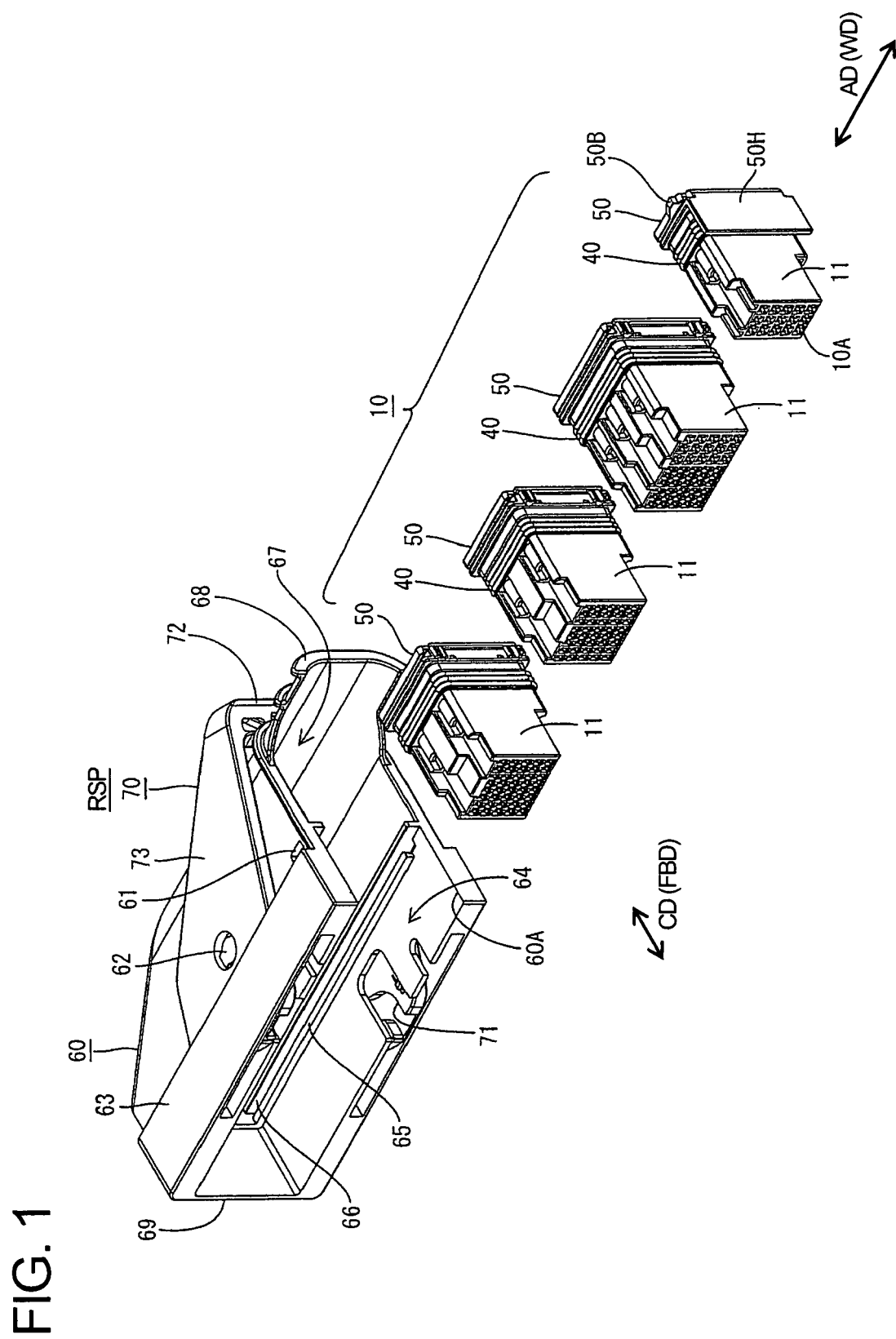


FIG. 2

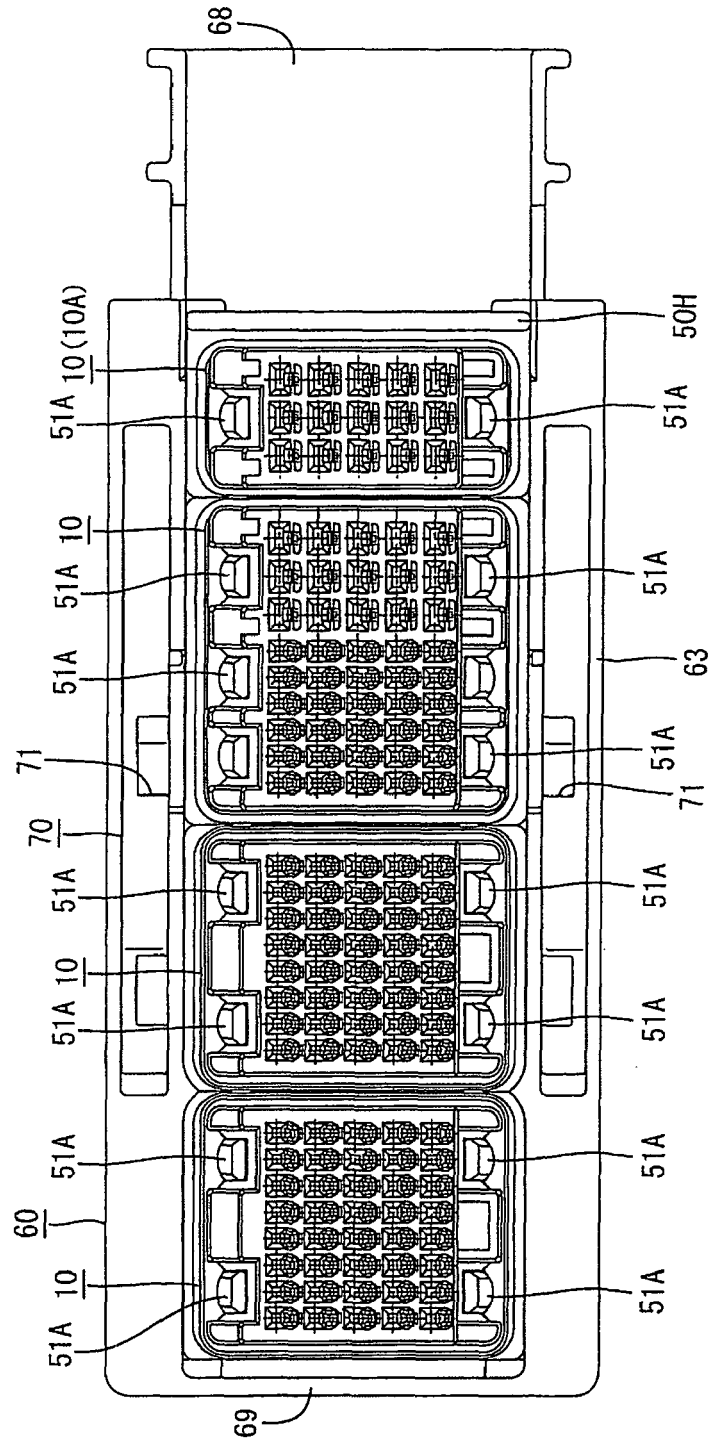


FIG. 3

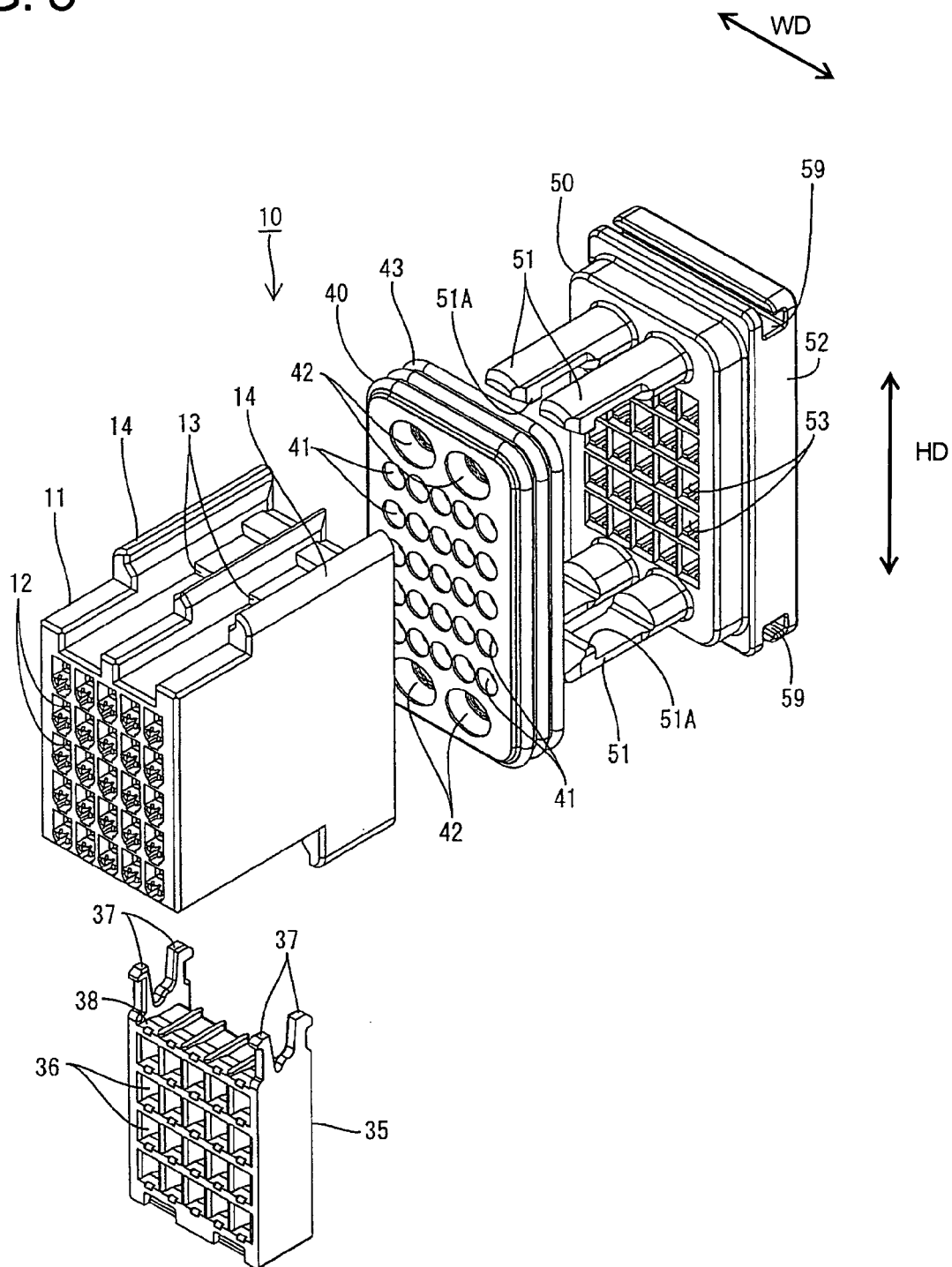


FIG. 4

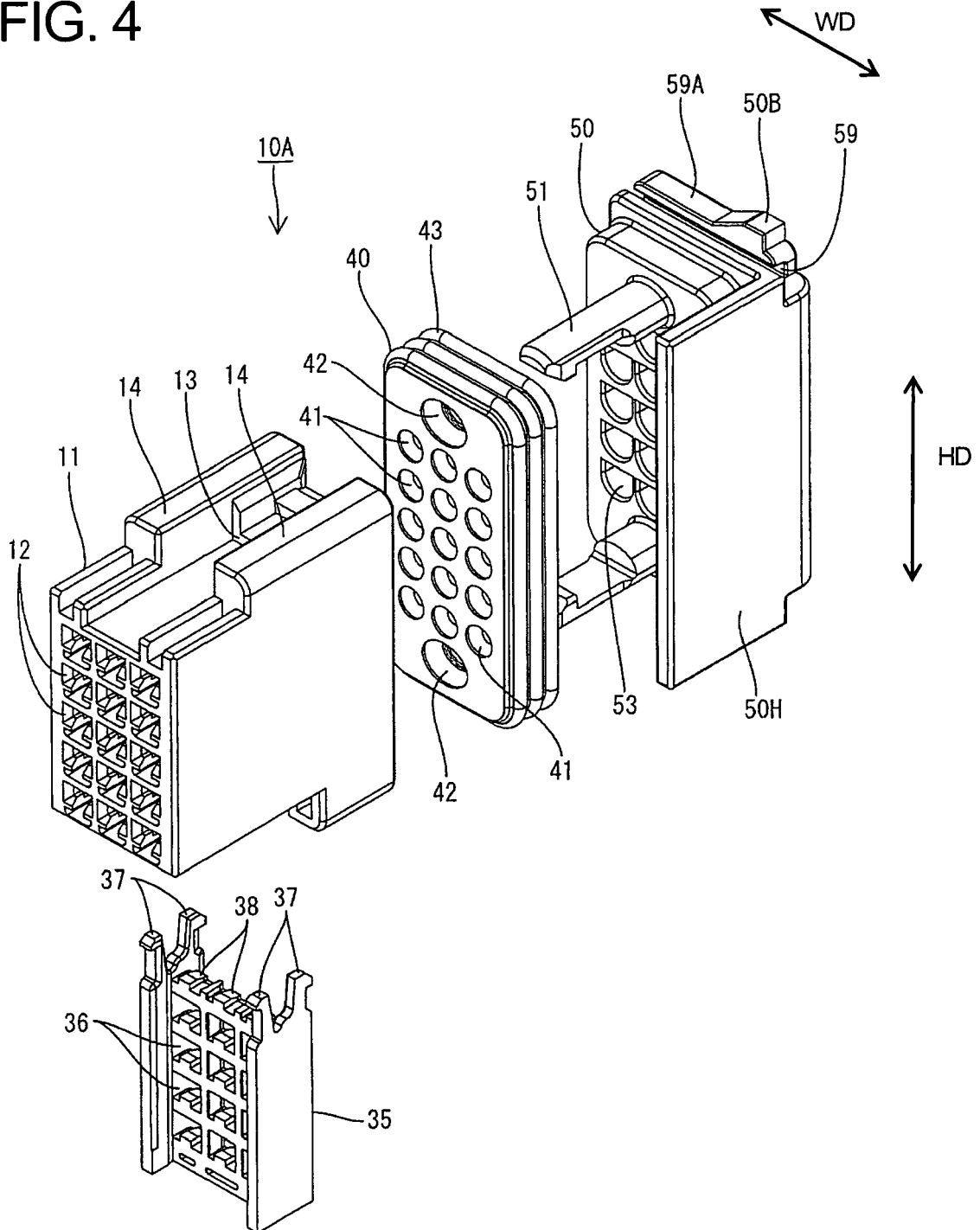


FIG. 5

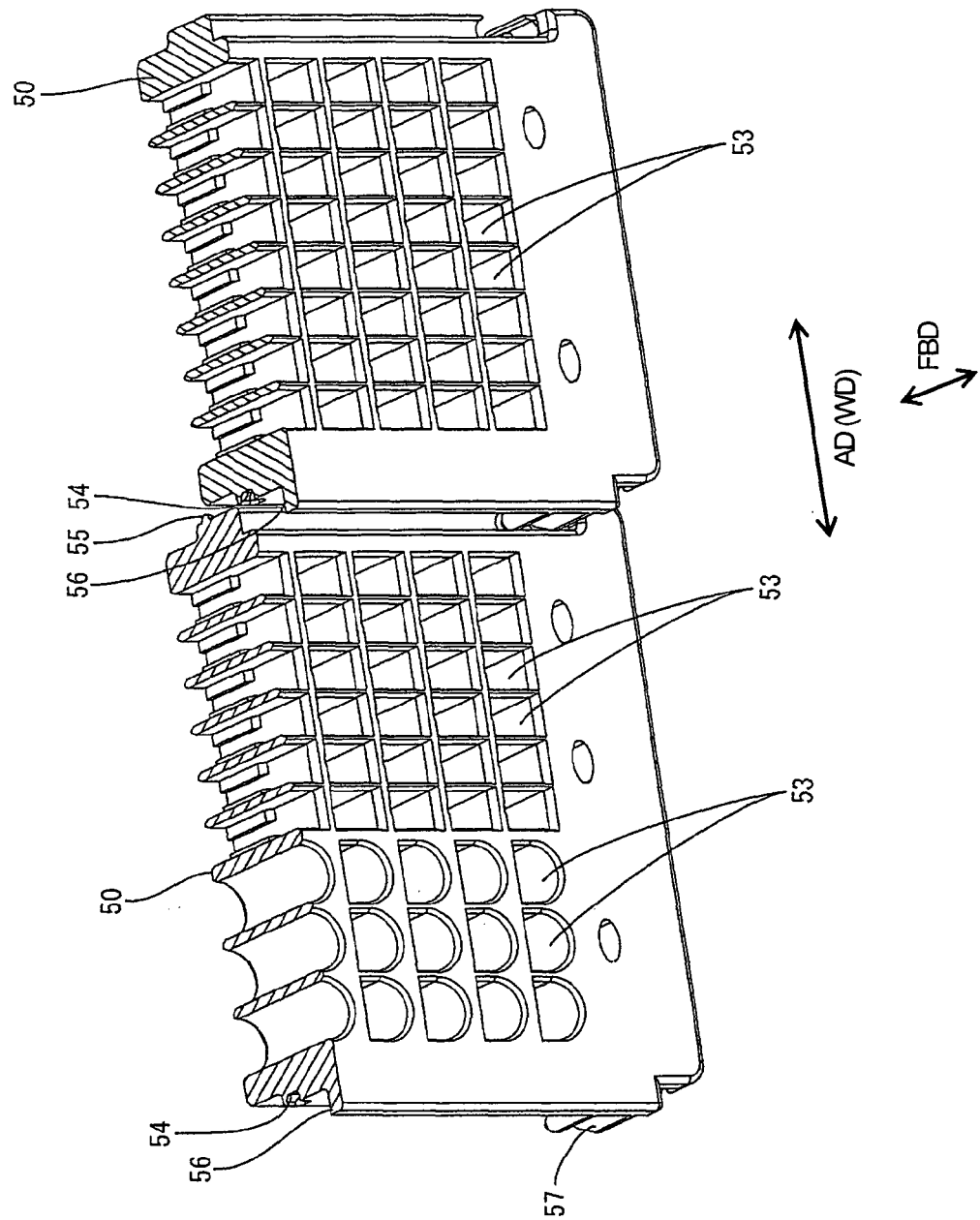


FIG. 6

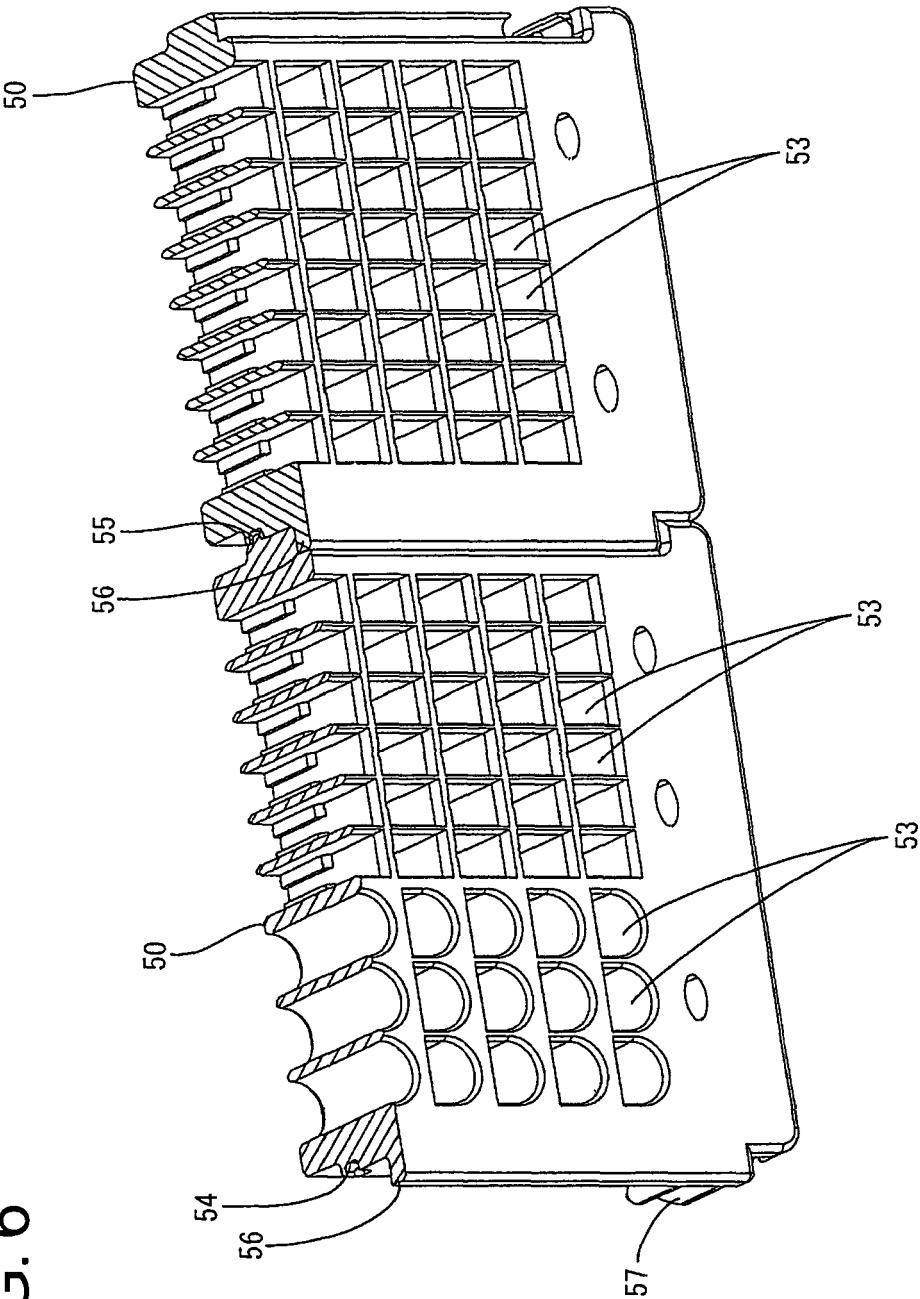


FIG. 7

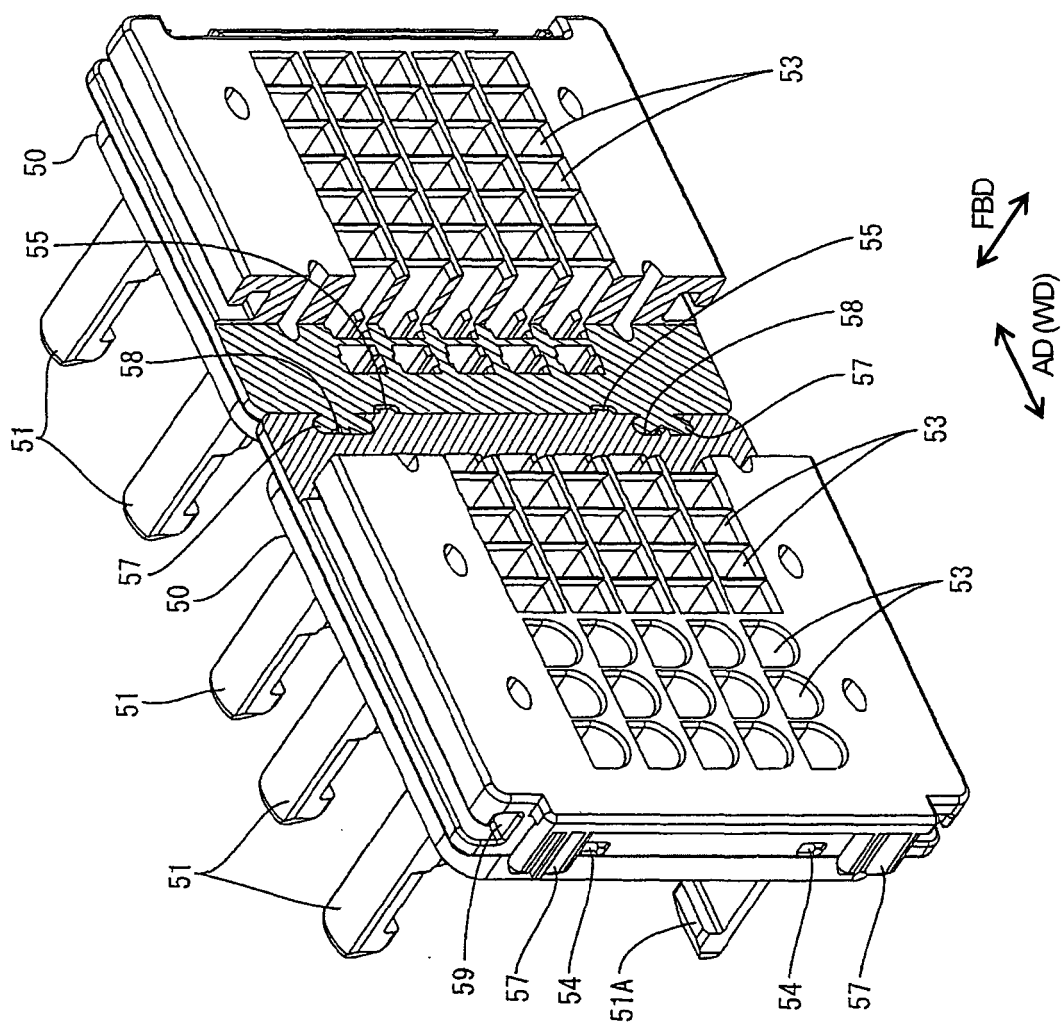


FIG. 8

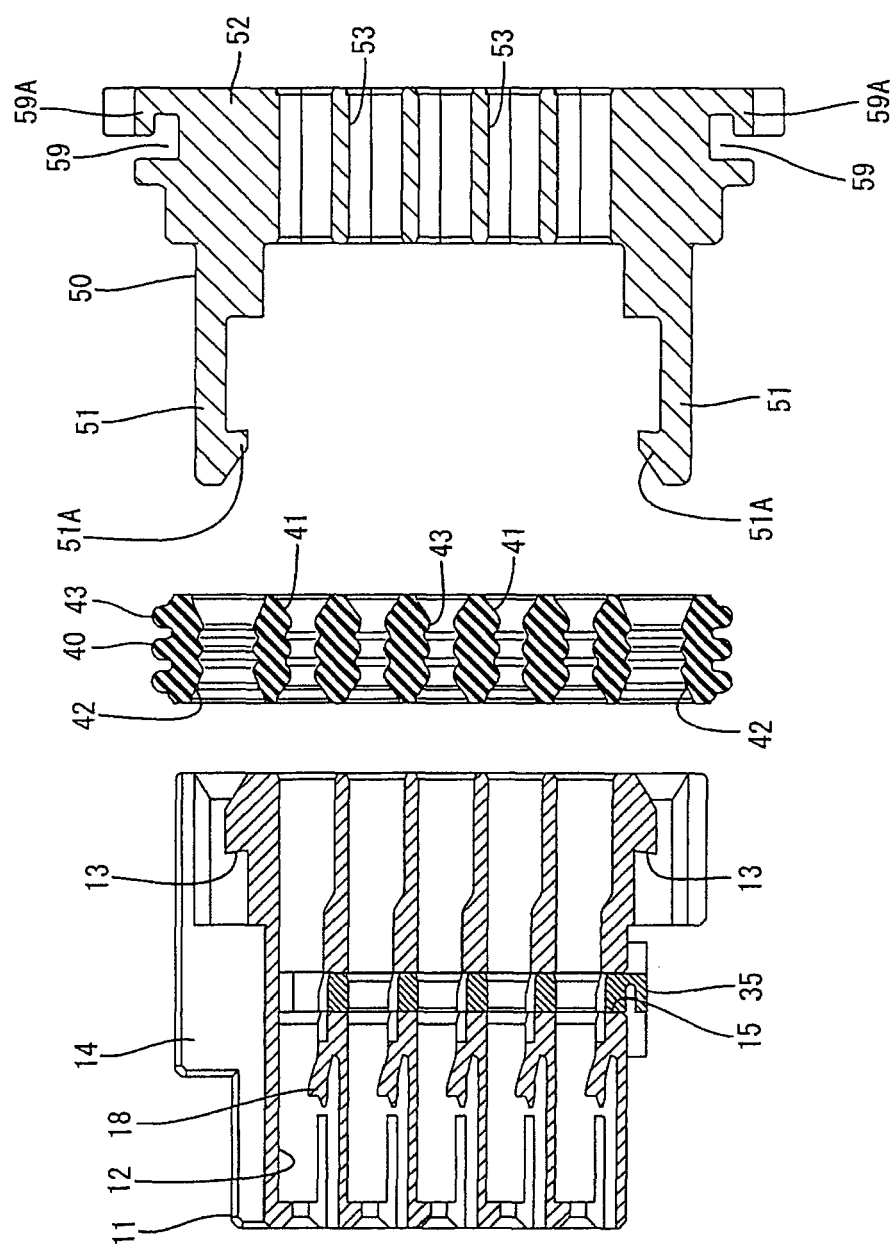


FIG. 9

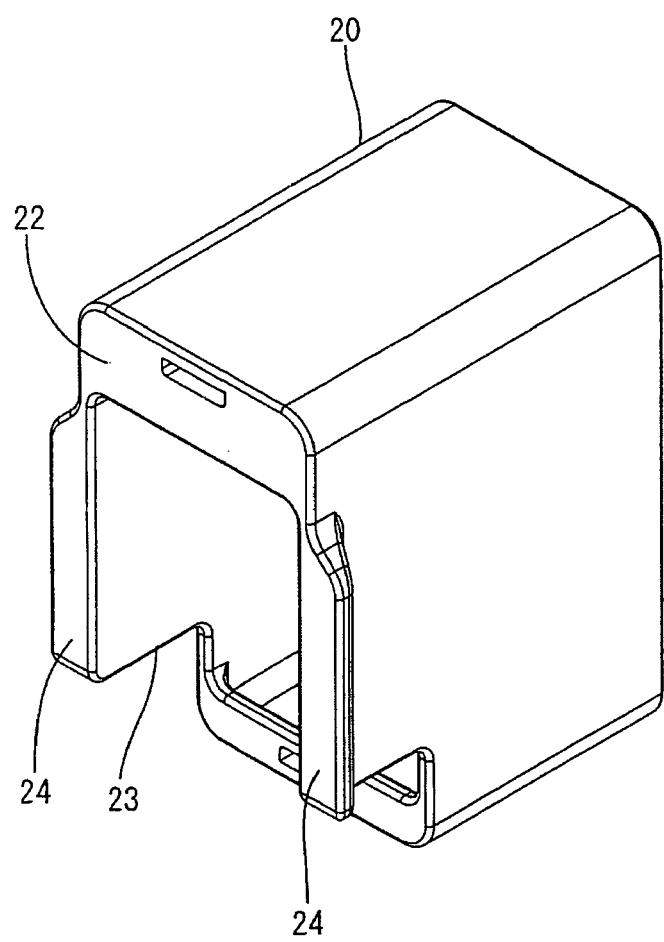


FIG. 10

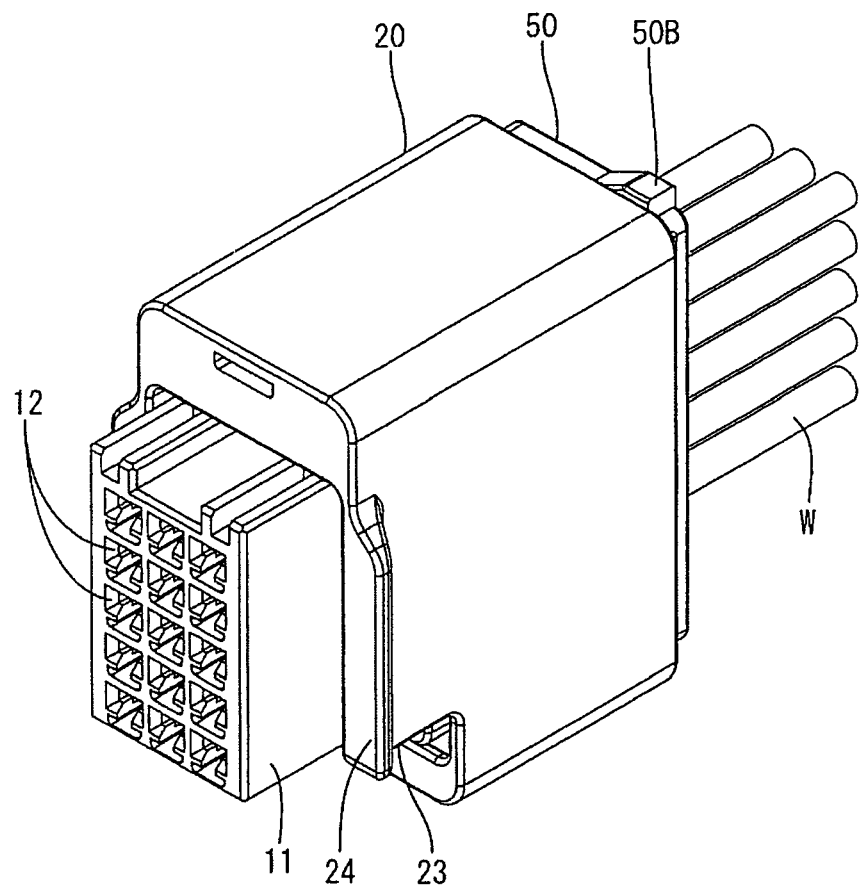


FIG. 11

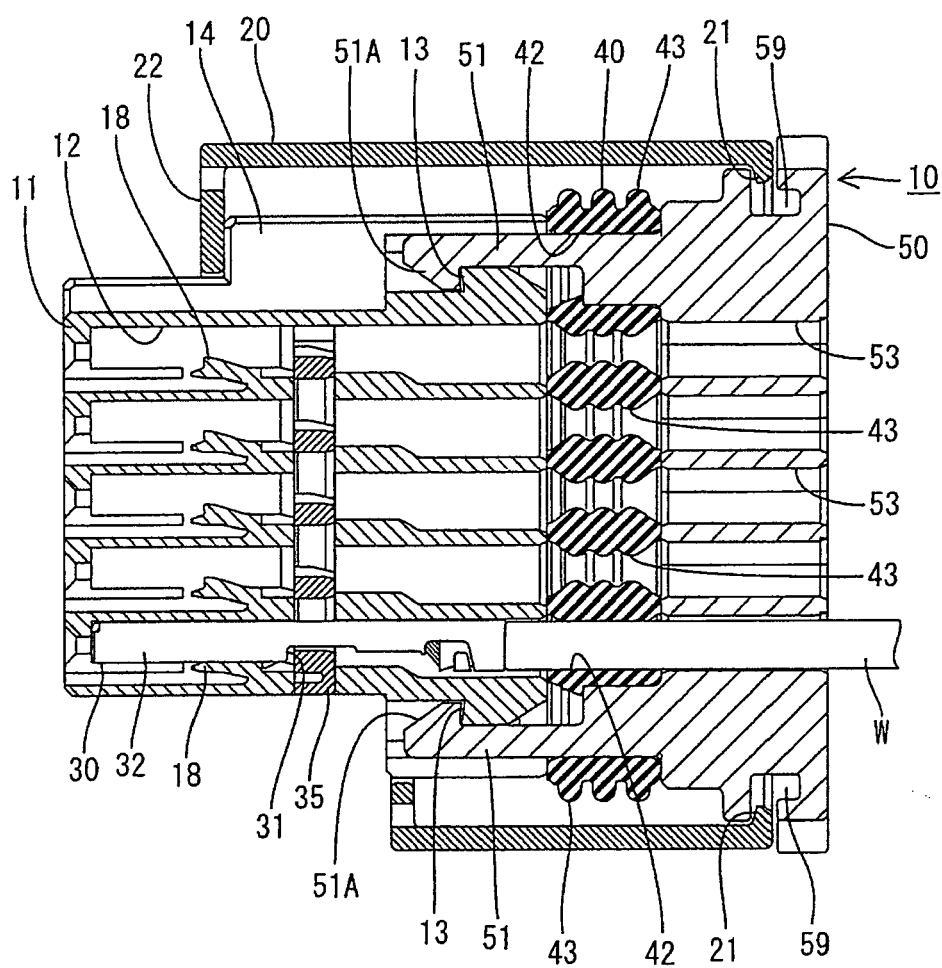


FIG. 12

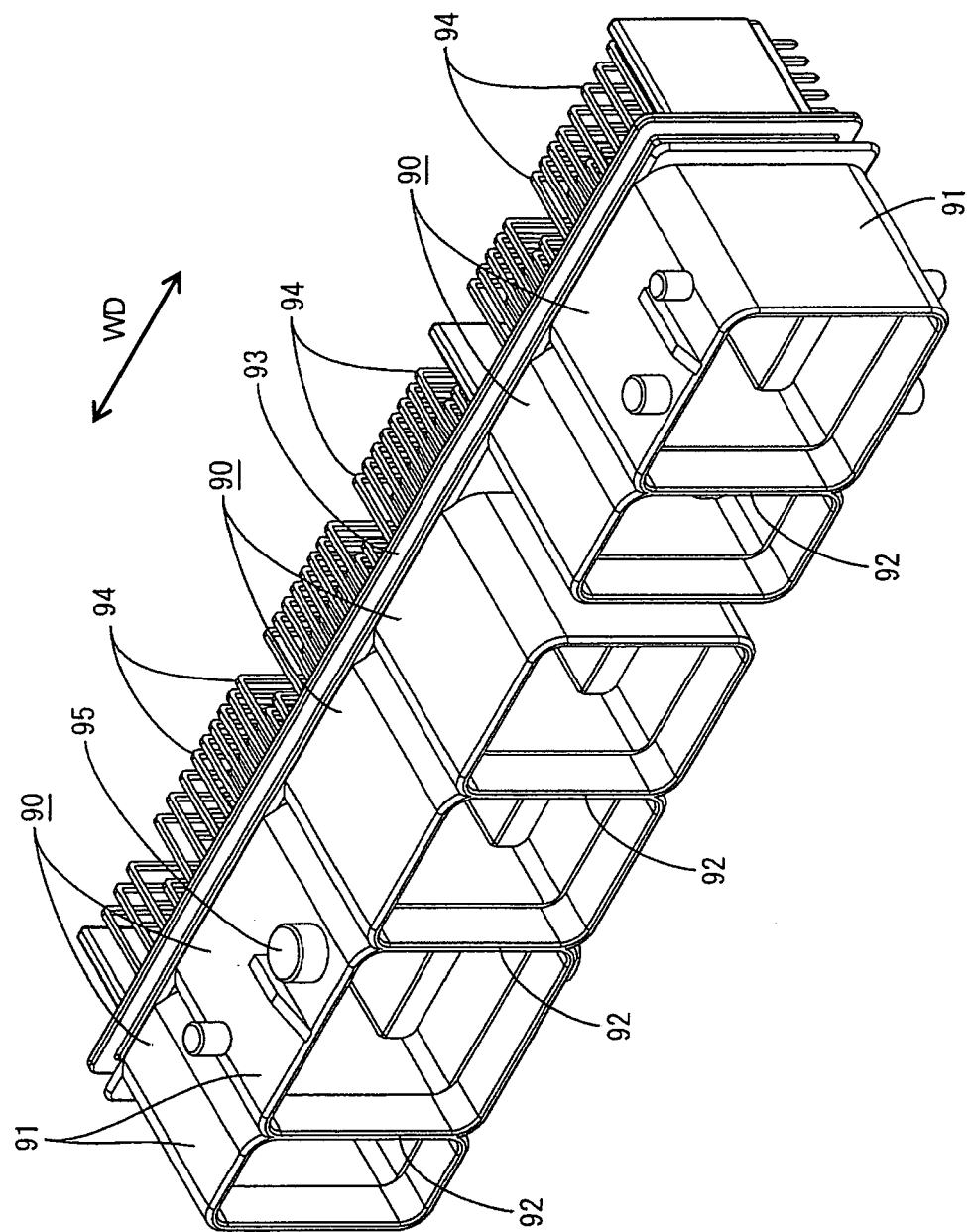
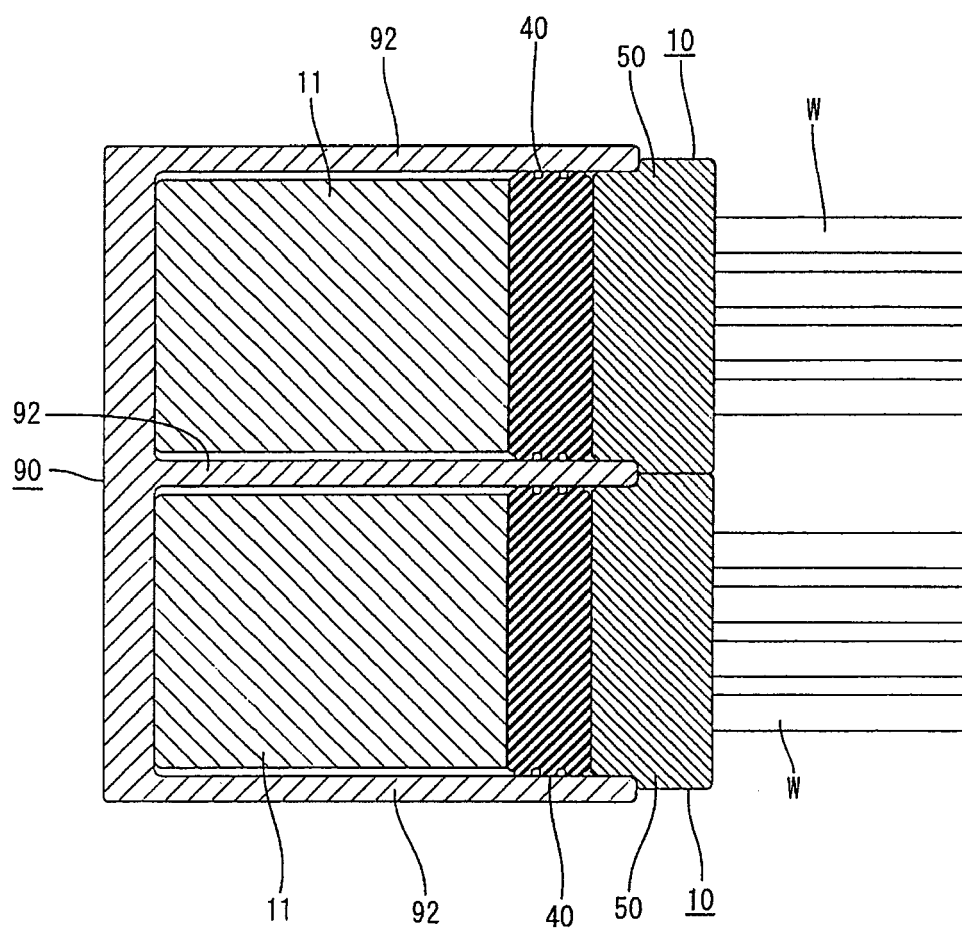


FIG. 13





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
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Place of search		Date of completion of the search	Examiner
Munich		5 September 2006	Arenz, R
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EPO FORM 1503 03.92 (P04C01)

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